Chapter 10

CHOOSING AMONG ALTERNATIVES

This chapter presents the module descriptions for the final trade-off evaluations of a CTSA, including the following modules:

- Risk, Competitiveness & Conservation Data Summary.
- Social Benefits/Costs Assessment.
- Decision Information Summary.

First, data summaries are prepared in the Risk, Competitiveness & Conservation Data Summary module, including a discussion of the uncertainties in the data and, in some cases, the significance of results (e.g., whether the risk characterization indicates a "clear," "possible," or "negligible" level of concern for a substitute). These data summaries provide the basic information needed for an individual decision-maker to consider the private (internal) benefits and costs of implementing a substitute.

Next, the data summaries are transferred to the Social Benefits/Costs Assessment module to evaluate the net benefits or costs to society of implementing a substitute as compared to the baseline. This involves a qualitative assessment of health, recreation, productivity, and other social welfare issues including benefits or costs that cannot be quantified in monetary terms. Thus, the Social Benefits/Costs Assessment module provides information needed to assess the external benefits and costs of implementing a substitute.

The results of the Risk, Competitiveness & Conservation Data Summary and the Social Benefits/Costs Assessment modules are combined in the Decision Information Summary module to identify the overall advantages an disadvantages of the baseline and the substitutes from both an individual business perspective and a societal perspective. The Decision Information Summary mmodule does not make value judgements or recommendations. The actual decision of whether or not to implement a substitute is made outside of the CTSA process.

RISK, COMPETITIVENESS & CONSERVATION DATA SUMMARY

OVERVIEW: The Risk, Competitiveness & Conservation Data Summary module organizes data from the risk, competitiveness, and conservation components of a CTSA together with data from the Process Safety Assessment, Market Information, and International Information modules. Data organized in this module are transferred to the Social Benefits/Costs Assessment module for analysis of: (1) the benefits and costs to the individual of alternative choices (referred to as private benefits and costs); and (2) the benefits and costs to others who are affected by the choices (referred to as external benefits and costs). Data are also transferred to the Decision Information Summary module where they are combined with the results of the Social Benefits/Costs Assessment to identify the overall advantages and disadvantages of the baseline and the substitutes.

GOALS:

- Compile data on the baseline to serve as a basis of comparison when evaluating the trade-offs among risk, competitiveness, and conservation.
- Compile data on each of the substitutes to identify the trade-offs among risk, competitiveness, and conservation issues associated with a substitute.
- Compile information on the uncertainties in the data that should be considered in the decision-making process.
- Develop simplified, interpretive summaries of the data that note clear distinctions in trade-off issues of the substitutes as compared to the baseline.
- Transfer data to the Social Benefits/Costs Assessment and Decision Information Summary modules.

PEOPLE SKILLS: The Risk, Competitiveness & Conservation Data Summary module requires the people skills outlined in the previous module descriptions for the analytical components of a CTSA, as well as the people skills required for the Social Benefits/Costs Assessment module. Completing this module should be a joint effort by all members of a DfE project team. Knowledgeable personnel and technical experts who completed the analytical modules are needed to evaluate results and identify uncertainties in the information.

DEFINITION OF TERMS: None cited.

APPROACH/METHODOLOGY: The following presents a summary of a general approach for organizing the data compiled in a CTSA. Methodology details for Steps 10 and 12 follow this section.

Risk

Step 1: Obtain data on environmental releases and transfers of pollutants from the Survey of Workplace Practices & Source Release Assessment module. Note any assumptions, scientific judgements, and uncertainties in the data. The Exposure Assessment module analyzes modeled or measured environmental concentrations of pollutants to determine exposure levels, but other effects of emissions (e.g., a smokestack that deposits soot on someone's laundry) may be considered in the Social Benefits/Costs Assessment.

Step 2: Review the Exposure Assessment module to determine the potential for chemical exposure via the evaluated pathways (e.g., dermal, inhalation, ingestion). In past CTSAs, exposure potential has been used as an indicator of risk potential when toxicity data were not available. Note any assumptions, scientific judgements, and uncertainties included in the assessment.

Step 3: Obtain data on the human health and environmental risks of alternatives from the Risk Characterization module. Note any assumptions, scientific judgements, and uncertainties included in the assessment.

Step 4: Review the Process Safety Assessment module to determine if the baseline or alternatives pose particular process safety hazards. List special precautions or actions that may be required to mitigate safety hazards.

Competitiveness

Step 5: Review the Regulatory Status module to determine which alternatives are regulated by environmental statutes, including any bans or restrictions that may affect availability. Alternatives being banned or phased-out should have been eliminated from consideration when the Regulatory Status module was completed. However, other alternatives may be under consideration for a ban or phase-out.

Step 6: Obtain data on the relative performance of the substitutes as compared to existing performance standards or as compared to the baseline from the Performance Assessment module. Note any assumptions, judgements, or uncertainties that should be reported with the performance data.

Step 7: Obtain the costs of alternatives from the Cost Analysis module. Note the assumptions and types of costs (e.g., operating, capital, indirect, etc.) that are included in the cost figures.

Step 8: Review the Market Information and International Information modules to identify any current or anticipated problems with the supply of or demand for the

substitutes. This can include supply shortfalls or international trade issues (e.g., taxes, tariffs, or prohibitions) that might limit the availability of a substitute.

Conservation

Step 9: Review the Energy Impacts and Resource Conservation modules for conservation data. Note alternatives that consume scarce resources or that are derived from nonrenewable resources.

Data Summaries and Data Transfer

Step 10: Construct data summary tables of the data obtained in Steps 1 through 9.

Step 11: Review the data for each alternative to determine the trade-off issues associated with any one substitute. Note changes in trends from the baseline to the substitutes (e.g., the baseline performs well, is cost-effective, but consumes large amounts of water and has a high potential for worker exposure; an alternative performs well, is expected to be cost-effective if supply/demand relationships stabilize; has reduced water consumption and potential for exposure as compared to the baseline).

Step 12: Using data from the baseline, trends among trade-offs identified in Step 11, and existing published guidance or data from modules describing the levels of concern for different parameters (e.g., risk assessment guidance on concerns for risk), develop simplified, interpretive summaries of the data that note clear distinctions in trade-off issues of a substitute as compared to the baseline.

Step 13: Transfer the risk, competitiveness, and conservation data summary information and any assumptions, judgements, or uncertainties that should be reported with the data to the Social Benefits/Costs Assessment and Decision Information Summary modules.

METHODOLOGY DETAILS: This section provides methodology details for completing Steps 10 and 12. In some cases, information on interpreting the significance of results can be found in the published guidance listed previously in other module descriptions.

Details: Steps 10 and 12, Constructing Data Summary Tables and Interpretive Summaries

In Step 10, relevant information from the CTSA can be structured in table, or matrix, format for ease of understanding. Data summaries that compare the substitutes to the baseline should be presented using some consistent unit of measure for each category. Table 10-1 is an example of a matrix that can be used to compare the impacts of alternatives on health and the environment. Data for the baseline and the alternatives should be included in the matrix. A DfE project team may show quantitative data in the matrices, or use symbols (e.g., "+" or "-") or text to illustrate

the impacts of the alternatives as compared to the baseline. Note that impacts which are stronger than others can also be recognized (e.g., high, medium, or low positives or negatives).

TABLE 10-1: EXAMPLE MATRIX OF ENVIRONMENTAL RELEASE AND RISK-RELATED DATA

Alternative	On-site Releases[a]			Off-site Transfers[a]			Risk[b,d]			
	Air	Water	Land	POTW[c]	Hazardous Waste Disposal	Recycling	Worker		General	
							Exposed Population	Risk Characterization	Exposed Population	Risk Characterization
Baseline										
Alternative 1										

a) Data on environmental releases and transfers are obtained from the Survey of Workplace Practices & Source Release Assessment and the Exposure Assessment modules (environmental releases and transfers that must be modeled).
b) Risk data are obtained from the Risk Characterization module. Quantitative data included here could include individual or population cancer and non-cancer risk to workers and other exposed human populations, and risk to aquatic organisms. Qualitative data might include an assessment of the potential for exposure to the health and environmental hazards identified in the Human Health Hazards and Environmental Hazards Summary modules.
c) Publicly Owned Treatment Works.
d) Data on population sizes are obtained or can be developed from the Survey of Workplace Practices & Source Release Assessment and Exposure Assessment modules.

Table 10-2 is an example matrix for compiling conservation information. The cost of energy and other resources should have already been incorporated in the Cost Analysis module. However, it is important to note the rate of resource consumption, or choices that consume scarce resources or that are derived from nonrenewable resources.

TABLE 10-2: EXAMPLE MATRIX OF CONSERVATION INFORMATION[a]

Alternative	Energy Consumption[b]		Other Resources Consumption[c]		
	Natural gas (BTU/hr)	Electricity (kWh/day)	Water (gallons/day)	Chemical Product (gallons/yr)	Machine Oil (gallons/mo)
Baseline					
Alternative 1					
Alternative 2					

a) Resource data are usually collected in units of mass or volume per unit time (m/t or L^3/t). To convert to mass or volume per unit production, multiply by the reciprocal of the production rate (e.g., 10 Btu/hr x 1 hr/50 widgets = 0.2 Btu/widget).
b) Energy data are obtained from the Energy Impacts module.
c) Other resource data are obtained from the Resource Conservation module.

To the extent possible, data should be normalized to some consistent basis, preferably per unit production ($/widget, Btu/widget, No. of product rejects/widgets produced, etc.). Normalization allows the baseline and substitutes to be compared directly. The following discusses the data summaries in more detail.

Exposure Potential and Health or Ecological Risk. The exposure potential and risk associated with using the baseline or a substitute can be presented together, particularly since risk is a function of exposure potential. For each system, qualitative descriptors could be used to list the potential for dermal (skin), inhalation, and ingestion exposure as high (+++), moderate (++), or low (+). Below each exposure scenario would be listed the corresponding risk level. Concerns for risk could be categorized as "clear," "possible," negligible," or "not quantified."

"Clear" concern indicates an inadequate margin-of-safety according to generally accepted risk assessment standards for exposure to the chemicals in question (see the list of published guidance in the Risk Characterization module). "Possible" concerns indicate that the margin-of-safety is slightly less than desirable and may not afford adequate protection in some circumstances. "Negligible" concerns indicate that an adequate margin-of-safety exists for exposure to the chemicals in question under the expected conditions of use.

For some chemicals evaluated in a CTSA, there may be insufficient data to quantify the risk, and although the exposure potential may be well-characterized, the precise risk cannot be quantified; these risks should be listed as "not quantified." Categorizing of risk into concern levels should only be undertaken by someone with expertise in accepted risk assessment standards.

Regulatory Status. Highlight alternatives that have a clearly different regulatory status as compared to the baseline or other alternatives. These might include alternatives being banned or phased-out, alternatives with no VOC content, or alternatives that do not use or contain regulated toxic chemicals.

Process Safety. Briefly summarize the safety hazards associated with the baseline in general. Use qualitative descriptors to indicate if an alternative improves working conditions by reducing safety hazards or may negatively influence working conditions by introducing a new safety hazard (e.g., "+" for improved safety; "-" for reduced safety). Special precautions or actions required to mitigate additional safety hazards of alternatives should be listed.

Performance. If performance data were collected on more than one measure of performance, the data can be combined into one overall assessment of the relative performance of a substitute or listed separately. If a substitute performs well, but fails to meet some traditional performance measure (e.g., the brightness requirement of virgin paper), it may be necessary to assess the performance measure to determine if industry standards are changing in response to environmental or other concerns.

Cost. Cost data should be provided in terms of dollars per unit production or some other consistent unit. The categories of costs (e.g., capital, operating, maintenance, indirect, etc.) and any assumptions that are included in the cost data should be clearly documented.

Energy and Resource Consumption. The types of energy or other resources evaluated and any assumptions should be clearly documented. If the project team focusses on a particular category of resources (e.g., water usage), information should be provided on the reasons for concern about the resource (e.g., continuing usage of large amounts of water could limit the industry's potential for growth; reliance on a scarce resource creates societal burdens and limits growth potential; mandated restrictions on use are anticipated, etc.).

Market and International Information. Businesses need to be aware of any expected supply shortfalls or international conditions that could limit the availability of a substitute. This information should also be briefly summarized.

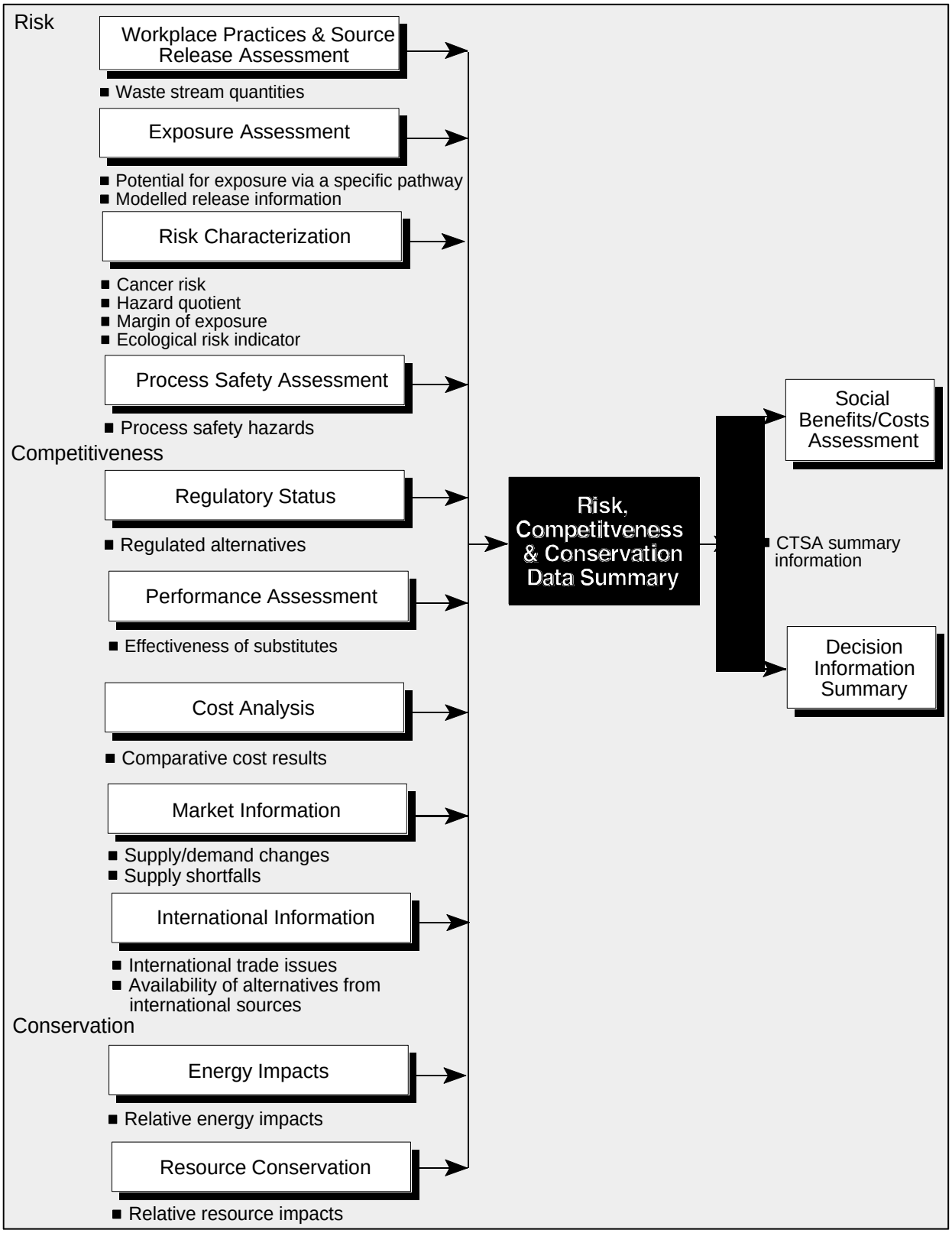
FLOW OF INFORMATION: This module summarizes the data on risk, competitiveness, and conservation compiled throughout a CTSA. The data summaries should report the technical data compiled in a CTSA in an understandable manner that will assist individual decision-makers in the decision-making process. The Risk, Competitiveness & Conservation Data Summary module receives data from the Workplace Practices & Source Release Assessment, Exposure Assessment, Risk Characterization, Process Safety Assessment, Regulatory Status, Performance Assessment, Cost Analysis, Market Information, International Information, Energy Impacts, and Resource Conservation modules. It transfers data to the Social Benefits/Costs Assessment and Decision Information Summary modules. Example information flows are shown in Figure 10-1.

ANALYTICAL MODELS: None cited.

PUBLISHED GUIDANCE: None cited.

DATA SOURCES: None cited.

FIGURE 10-1: RISK, COMPETITIVENESS & CONSERVATION DATA SUMMARY MODULE: EXAMPLE INFORMATION FLOWS



SOCIAL BENEFITS/COSTS ASSESSMENT

OVERVIEW: Policy makers decide on policies for society in part by utilizing social benefits/costs assessment to evaluate the impact of those decisions on others. Social benefits/costs assessment is the process of systematically evaluating the impacts made on all of society by individual decisions. It includes the benefits and costs to the individual of alternative choices (referred to as private benefits and costs) and the benefits and costs to others who are affected by the choices (referred to as external benefits and costs). Public decision-makers utilize social benefits/costs assessment to choose the best alternative among several options. Benefits are determined by the differences in risks between the baseline system or product and the alternative; costs are determined by the differences in the costs of using the alternative system versus the baseline. The criterion is to choose the alternative with the largest net benefits, i.e., the alternative with the largest positive difference between benefits and costs. Social benefits/costs assessment is important because it provides a complete view of the effects of alternative choices regarding pollution, allowing the policy maker to make choices based upon both private and external benefits and costs.

In a free market economy, firms typically make decisions based upon the knowledge at hand in order to maximize profits. However, this is often without full knowledge of the effects of those decisions on others. Private effects could include changes in worker productivity, worker compensation claims, liability claims, hazardous waste disposal costs, costs of meeting regulatory requirements, and sales due to negative or positive publicity. External effects include the effects of pollution on health, recreation, and productivity, which ultimately can impact publicity (related to sales and good will) and liability. By considering these effects, social benefits/costs assessment can be used by industry to improve the outcome of decision-making for a business and for society as a whole. Further information on the relevance of social benefits/costs assessment can be found in the Methodology Details section of this module.

GOALS:

- Describe expected private and external benefits of the alternatives relative to the baseline, including any beneficial effects that cannot be quantified in monetary terms and the identify of those likely to receive the benefit.

- Describe expected private and external costs of the alternatives relative to the baseline, including any adverse effects that cannot be quantified in monetary terms and the identify of those likely to bear the costs.

- Determine the potential net benefits (benefits minus costs) of the alternatives as compared to the baseline, including an evaluation of effects that cannot be quantified in monetary terms.

PEOPLE SKILLS: The following lists the types of skills or knowledge that are needed to complete this module.

- Knowledge of social benefits/costs assessment of human health and environmental risk management options.

Within a business or DfE project team, the people who might supply these skills include an economist or a policy analyst.

DEFINITION OF TERMS:

Benefit: A benefit is the value to society of a good or service. From a firm's perspective, the benefit of a good or service can be measured by the revenue the firm receives from its sales as compared to the costs incurred when producing its products. From the consumer's perspective, the benefit can be measured by what the consumer would be willing to pay for the good or service. Some goods and services, such as environmental amenities and health risk reductions, are not generally for sale in a market economy. However, these goods and services do provide benefits to society which should be recognized. Economists attempt to estimate the value of these goods and services through various nonmarket valuation methods, which are briefly described in the Methodology Details section below.

Direct Medical Costs: Costs associated specifically with the identification and treatment of a disease or illness (e.g., costs of visits to the doctor, hospital costs, costs of drugs).

Discounting: Economic analysis procedure by which monetary valuations of benefits and/or costs occurring at different times are converted into present values which can be directly compared to one another.

Exposed Population: The estimated number of people from the general public or a specific population group who are exposed to a chemical, process, and/or technology. The general public could be exposed to a chemical through wide dispersion of a chemical in the environment (e.g., DDT). A specific population group could be exposed to a chemical due to its physical proximity to a manufacturing facility (e.g., residents who live near a facility using a chemical), through the use of the chemical or a product containing a chemical, or through other means.

Exposed Worker Population: The estimated number of employees in an industry exposed to the chemical, process, and/or technology under consideration. This number may be based on market share data as well as estimations of the number of facilities and the number of employees in each facility associated with the chemical, process, and/or technology under consideration.

Externality: A cost or benefit that involves a third party who is not a part of a market transaction; "a direct effect on another's profit or welfare arising as an incidental by-product of some other person's or firm's legitimate activity" (Mishan, 1976). The term "externality" is a general term which can refer to either external benefits or external costs.

External Benefits: A positive effect on a third party who is not part of a market transaction. For example, if an educational program (i.e., a smoking-cessation class) results in behavioral changes which reduce the exposure of a population group to a disease (i.e., lung cancer), then an external benefit is experienced by those members of the group who did not participate in the educational program (i.e., those inhaling second-hand smoke). External benefits also occur when environmental improvements enhance enjoyment of recreational activities (e.g., swimming, hiking, etc.).

External Costs: A negative effect on a third party who is not part of a market transaction. For example, if a steel mill emits waste into a river which poisons the fish in a nearby fishery, the fishery experiences an external cost to restock as a consequence of the steel production. Other examples of external costs are the effects of second-hand smoke on nonsmokers, increasing the incidence of respiratory distress, and a smokestack which deposits soot on someone's laundry, thereby incurring costs of relaundering.

Human Health Benefits: Reduced health risks to workers in an industry or business as well as to the general public as a result of switching to less toxic or less hazardous chemicals, processes, and/or technologies. An example would be switching to a less volatile chemical or a new method of storing or using a volatile, hazardous chemical, to reduce the amount of volatilization, thereby lessening worker inhalation exposures as well as decreasing the formation of photochemical smog in the ambient air.

Human Health Costs: The cost of adverse human health effects associated with production, consumption and disposal of a firm's product. An example is the cost to individuals and society of the respiratory effects caused by stack emissions, which can be quantified by analyzing the resulting costs of health care and the reduction in life expectancy, as well as the lost wages as a result of being unable to work.

Illness Costs: A financial term referring to the liability and health care insurance costs a company must pay to protect itself against injury or disability to its workers or other affected individuals. These costs are known as illness benefits to the affected individual. Appendix J summarizes several cost of illness valuation methods.

Indirect Medical Costs: Indirect medical costs associated with a disease or medical condition resulting from exposure to a chemical, product or technology. Examples would be the costs of decreased productivity of patients suffering a disability or death and the value of pain and suffering borne by the afflicted individual and/or family and friends.

Individual Risk: An estimate of the probability of an exposed individual experiencing an adverse effect, such as "1 in 1,000" (or 10^{-3}) risk of cancer.

Net Benefit: The difference between the benefits and the costs. For a company this could be interpreted as revenue - costs, assuming that the revenue and the costs are fully determined.

Opportunity Cost: A hidden or implied cost incurred due to the use of limited resources such that they are not available for an alternative use. For example, the use of specific laborers in the production of one product precludes their use in the production of another product. The opportunity cost to the firm of producing the first product is the lost profit from not producing the second. Another example would be a case where in hiring legal representation to respond to a lawsuit, and due to limited financial resources, a firm must cancel a planned expansion. The opportunity cost of responding to the lawsuit is the lost gain from not expanding.

Population Risk: An aggregate measure of the projected frequency of effects among all exposed people, such as "four cancer cases per year."

Present Value: The value in today's terms of a sum of money received in the future. Present Value is a concept which specifically recognizes the time value of money, i.e., the fact that $1 received today is not the same as $1 received in ten years time. Even if there is no inflation, $1 received today can be invested at a positive interest rate (say 5 percent), and can yield $1.63 in ten years; $1 received today is the same as $1.63 received ten years in the future. Alternately, the present value of $1 received in ten years is $0.61. The rate at which future receipts are converted into present value terms is called the discount rate (analogous to the interest rate given above). The formula for calculating present value is given in the Cost Analysis module.

Private (Internalized) Benefits: The direct gain received by industry or consumers from their actions in the marketplace. One example includes the revenue a firm obtains in the sale of a good or service. Another example is the satisfaction a consumer receives from consuming a good or service.

Private (Internalized) Costs: The direct negative effects incurred by industry or consumers from their actions in the marketplace. Examples include a firm's cost of raw materials and labor, a firm's costs of complying with environmental regulations, or the cost to a consumer of purchasing a product.

Social Benefit: The total benefit of an activity that society receives, i.e., the sum of the private benefits and the external benefits. For example, if a new product prevents pollution (e.g., reduced waste in production or consumption of the product), then the total benefit to society of the new product is the sum of the private benefit (value of the product that is reflected in the marketplace) and the external benefit (benefit society receives from reduced waste).

Social Cost: The total cost of an activity that is imposed on society. Social costs are the sum of the private costs and the external costs. Therefore, in the example of the steel mill, social costs of steel production are the sum of all private costs (e.g., raw material and labor costs) and the sum of all external costs (e.g., the costs associated with replacing the poisoned fish).

Willingness-to-Pay: Estimates used in benefits valuation intended to encompass the full value of avoiding a health or environmental effect, which are often not observable in the marketplace. For human health effects, the components of willingness-to-pay include the value of avoided

pain and suffering, impacts on the quality of life, costs of medical treatment, loss of income, and, in the case of mortality, the value of a statistical life.

APPROACH/METHODOLOGY: The following presents a summary of the approach or methodology for conducting a social benefits/costs assessment. This should be used as a general guideline. After completing this procedure, it will be possible to compare the baseline with the alternatives for both private and external benefits and costs. It should be recognized that not all benefits may be quantifiable, but they should still be considered in a qualitative manner. Further information on the relevance of and framework for quantitative social benefits/costs analysis and methodology details for Steps 7 through 11 follow this section. Appendix I presents the social benefits/costs assessment from the Lithography CTSA.

Step 1: Obtain risk, competitiveness, and conservation data summary information, including interpretive data summaries, from the Risk, Competitiveness & Conservation Data Summary module. The risk summary information may include data on environmental releases and transfers of pollutants, chemical exposure levels, health and environmental risks from toxic chemical exposure, and process safety information. The competitiveness summary information may include information on the regulatory status of chemicals, performance data, cost data, as well as market information and international information related to the availability of a substitute. The conservation data summary typically describes energy impacts and effects on resource conservation.

Step 2: From the competitiveness summary, eliminate any alternatives that exhibited clearly unacceptable performance or that are banned or being phased-out. Keep in mind that there may be a variety of reasons that an alternative did not work (e.g., standards that are more stringent than necessary, worker apprehension, or misuse of the alternative due to lack of familiarity), and that some of these conditions may change over time. For instance, recycled paper has become acceptable in many circumstances even though it doesn't have the brightness attainable with virgin feedstock.

Step 3: Review data in the risk summary on the relative risk of alternatives, as compared to the baseline. This provides information necessary to determine both private and external effects. For instance, improving a worker's health may lead to fewer sick days and possibly a more productive employee and therefore provides private benefits. External benefits include the reduction in health care cost, which may lead to lower overall premiums. It may be necessary to review exposed population and release and transfer information included in the risk summary, particularly if chemical toxicity data were not available.

Step 4: Review data on the process safety hazards posed by the baseline and alternatives. This provides information about the relative safety of the various alternatives. Replacing a carcinogen with a fire hazard may or may not be appropriate.

Step 5: Review the rates of energy and natural resource consumption of the baseline and alternatives from the conservation summary. Differences in operating costs, which should incorporate the cost of energy and other resources, should have already been incorporated in the Cost Analysis module. However, it is important to note choices that consume scarce resources or that are derived from nonrenewable resources, as conservation of those resources could play an important role. In addition, as scare resources are used, there is a potential for them to become more costly.

Step 6: Using quantitative risk characterization data from the risk summary, if available, quantify changes in individual or population risks as a result of implementing an alternative as compared to the baseline. Options that reduce risk provide the social benefit of reduced mortality and morbidity.

Step 7: For all of the data in the risk, competitiveness and conservation data summaries, identify other potential external effects (in addition to quantitative individual or population risk) of implementing an alternative as compared to the baseline. For examples of potential effects see the Methodology Details section, below.

Step 8: For each effect identified in Steps 3 through 7, identify which relate to private or external effects and the affected populations (e.g., workers at a facility, consumers using the finished product, persons fishing in the stream that receives pollutants, etc.). Some of this information will be summarized in the risk summary from the Risk, Competitiveness & Conservation Data Summary module.

Step 9: Evaluate the effects of each alternative compared to the baseline to determine if the effects are beneficial to society or create additional societal burdens. These effects would not necessarily be considered by firms in typical business planning. However, consideration of the effects of each alternative could eventually affect a firm's profitability in the long run by increasing employee productivity, lowering the potential for lawsuits, reducing the likelihood of regulation, or through other means. Keep in mind that the larger the societal effect, the greater the potential for future regulation.

Step 10: Compare the results of Step 9 to the results of the cost analysis, performance assessment, and other competitiveness data (regulatory status, market availability of a substitute, etc.) found in the competitiveness summary. For example, does the alternative increase or decrease private costs (e.g., capital costs, operating and maintenance costs)? Does the alternative perform as well as or better than the baseline, resulting in a product with increased societal value? Keep in mind that performance may be acceptable even if different from the baseline. (Recall the example about the acceptability of recycled paper given in Step 2.) Are there environmental regulations affecting the alternative? Is the supply of a substitute stable?

Step 11: Use the results of Steps 9 and 10 to qualitatively evaluate the net benefits or costs of the alternatives. For example, the value of reduced human health risks would most likely greatly exceed the value of slightly higher operating costs. To develop a quantitative estimate of net benefits or costs economists monetize benefits using the concepts of willingness-to-pay and discounting. There are many texts which describe various monetization techniques (see sections on analytical models and published guidance for references on quantitative social benefits/costs analysis). The Cost Analysis module gives the formula for calculating present value.

Step 12: Transfer the results of the Social Benefits/Costs Assessment to the Decision Information Summary module.

METHODOLOGY DETAILS: This section presents further information on the relevance of and framework for social benefits/costs analysis and provides methodology details for completing Steps 7 through 11. If necessary, additional information on this and other steps can be found in previously published guidance (see section on published guidance).

Relevance of Social Benefits/Costs Analysis

Imagine a pasture which is open for common use by cattle producers in a community. Every cow that grazes on the pasture represents additional revenue a producer can receive, with no additional cost to the producer for grazing. Therefore, with other costs held constant, each producer has an incentive to graze as many cows as possible on the pasture. Since every producer has the same incentive, the pasture can easily become overgrazed, resulting in the eventual destruction of the pasture and the elimination of the food supply for the cattle. There was no incentive for a single producer to constrain use of the common resource in order to preserve it, thereby resulting in the ruin of free pasturage for all.

A similar problem occurs with pollution. Each generator of waste may find it cheaper to emit wastes into the environment than to treat the wastes, or to use an alternative process which does not cause the wastes. However, with many generators of wastes, the ability of the environment to assimilate wastes becomes overwhelmed, and pollution results. Increases in pollution lead directly to reductions in the quality of life in the affected area.

The fundamental similarity in each case is that a resource is being used, but no recognition of the costs of its use is being acknowledged. If the resource were privately held, the owner would have the right to demand payment for the use of the resource and has an incentive to prevent use of the resource to the point of destruction. However, in many instances, private ownership is not feasible - for example, ownership rights of the air for assimilating emissions have not generally been established in market economies. Therefore, failure to recognize the costs of utilizing a resource will eventually lead to its overuse, and in some cases, its destruction.

The approach to solving this problem that has generally been used in the U.S. is for the government to assume responsibility for commonly held resources such as the air, and to impose limits on their use through the implementation of standards, technology requirements, and other policies. Social benefits/costs analysis is the means by which the services of these resource are valued in developing these policies. Social benefits/costs analysis also provides information to decision-makers about what levels of standards and what types of technology requirements would allow the most efficient use of commonly held resources. Companies can be proactive in their use of common resources and employ social benefits/costs analysis in making decisions about technology choices.

Framework for Social Benefits/Costs Analysis

Social benefits/costs analysis is widely used in government. Its function is to help decision-makers choose the policy option which is best from society's perspective among a choice of several alternative options. The criterion used is to choose the option which yields the greatest net benefit, i.e., the option for which the difference between social benefits and costs is the largest. Since benefits and costs are measured from a societal perspective, all the private and external effects are considered. Oftentimes it is easier to estimate the costs of policy alternatives than the benefits of those alternatives; information on such factors as the costs to business of new technology, the costs to consumers of higher prices, etc., is more readily available than information on the value of reduced health risks or the value of an endangered species.

Economists attempt to place a monetary value on benefits such as reduced health risks and environmental improvements for policy decision-making because monetizing benefits makes them easier to compare to costs, and therefore makes them less likely to be ignored. While monetization of benefits may likely be difficult for a DfE or other CTSA development team given resource limitations, a very brief overview of benefits estimation is given here to help convey the concept of social benefits/costs analysis. It is also given to assist those firms or industry groups that do have the resources to do quantitative social benefits/costs analysis, rather than the qualitative assessment that is the focus of this module.

The main methods economists use in valuing social benefits include travel cost techniques, hedonic pricing, and contingent valuation. These willingness-to-pay estimates are then used to estimate a total benefit to society of the potential improvement. Travel cost methods use an estimate of how much people actually spend on trips to environmental sites as the basis for calculating the value of benefits at those sites. Hedonic pricing methods use wage or price differentials to estimate market valuations of health risks on the job or environmental problems such as air pollution. Contingent valuation is a survey method in which individuals are asked what they would be willing to pay for health or environmental benefits, such as reduced health risk, improved air or water quality, or preservation of an endangered species.

The benefits estimation techniques described here are highly resource-intensive, and are not generally conducted in the EPA Office of Pollution Prevention and Toxics. Instead, economic literature reviews can provide information on existing studies, from which social benefits

estimates can be drawn. However, if resources and information are too limited to conduct a quantitative analysis, then a qualitative analysis will provide useful information.

Cost analysis is conducted by identifying all the relevant inputs (e.g., labor, equipment, energy) to a production process, and placing a monetary value on the use of these inputs for a given production level or time period. The monetary value of the inputs is their price times the amount used in the process. In this way, performance is incorporated into the analysis. Price and use information can be obtained from supplier, industry associations, etc. The cost analysis is repeated for each alternative under consideration. All direct and indirect costs, including less tangible costs such as liability costs, should be included in the analysis.

Again, the importance of the social benefit/cost analysis is not to develop a precise numerical estimate of social benefits and costs, but to use a systematic form of analysis in order to identify the best alternative among a choice of several possible options. The quantitative following approach discussed in this module can be used when a project team has limited resources and/or limited information.

Details: Steps 7 through 11, Identifying and Evaluating Social Benefits and Costs

External Effects of Pollution

Recall that externalities are effects on third parties who are not part of a market transaction. Market economies do not implicitly have mechanisms which consider these effects. Failure to recognize external costs means that costs are being imposed on someone else. Legislative, administrative, or judicial remedies can often be imposed on perpetrators, therefore recognition of the external effects on others can be a proactive business decision. Freeman (1982) lists the following external effects of pollution:

Effects on Living Systems (Involving Biological Mechanisms)

1. Human health
    a. mortality
    b. morbidity
2. Economic productivity of ecological systems
    a. agriculture
    b. commercial fisheries
    c. forestry
3. Other ecological system effects impinging directly on human activities
    a. sports fishing
    b. hunting
    c. wildlife observation
    d. water-based recreation
    e. home gardening and landscaping
    f. commercial, institutional, public landscaping
4. Ecological system effects not directly impinging on humans
    a. species diversity
    b. ecosystem stability

Effects on Nonliving Systems

1. Producers
    a. damages to materials, for example, corrosion
    b. soiling
    c. reduction in product quality
2. Households
    a. damages to materials
    b. soiling
3. Changes in weather and climate
4. Other
    a. visibility
    b. tranquility

In addition to the external effects of pollution from operating plants, externalities also occur from consumption of energy or nonrenewable resources. For example, economists say that energy is not priced optimally because the price does not reflect the value of the externalities that occur from energy production and use. A decrease in energy consumption will reduce these externalities, resulting in social benefits.

Evaluating the Effects of Alternatives on Society

Examples of the types of questions that could be asked in evaluating these effects are: Would the alternative avoid or mitigate illness or disease when compared to the baseline? Would the alternative reduce employee absence or turnover through the provision of a better workplace? Would the alternative improve air quality by decreasing the cumulative air emissions from the industry as a whole? Would the recreational value of streams and rivers be improved due to decreases in the environmental loading of pollutants from all businesses in the industry? Would the alternative decrease the cumulative hazardous waste from the industry, thus requiring less land for hazardous waste disposal? Note that some effects may have substantially stronger positives and negatives than others. This should be taken into consideration.

Developing Social Benefits and Costs Information

For the baseline and each alternative, the social (private and external) benefit and cost information should now be developed. This type of information can be identified from data reviewed in Steps 3 through 6 (obtained from the Risk, Competitiveness & Conservation Data Summary module), and from additional information obtained in Steps 7 through 10.

For an example of how to develop this information, suppose we are currently using a chemical in a production process (the baseline) which has the following concerns:

(1) It can cause both acute (for nausea) and chronic (for lung disease) worker health risks.
(2) It has a noxious odor both in the plant and in the surrounding area.

(3) It is a hazardous substance, and must be disposed of in a hazardous waste facility. This poses a threat of groundwater contamination by the landfill, and subsequent liability problems.
(4) Some of the chemical is released into waste water, and could be contributing to the reduced stock of gamefish in a nearby reservoir.

Alternative 1 is being considered which would avoid use of this chemical entirely, but it has the following problems:

(1) It would require investment in new equipment.
(2) It would utilize more energy, resulting in higher energy costs and an increase in emissions from energy production or consumption to the air.
(3) It is more labor intensive, leading to higher labor costs.
(4) It results in a slightly inferior final product.

From information contained in the risk, competitiveness and conservation data summaries, it is possible to say something, even if qualitative, about the impact on social benefits and costs from changing from the Baseline to Alternative 1. For example, the risk characterization summary should show that there are health concerns for acute and chronic conditions associated with the Baseline that do not exist with Alternative 1. The risk summary will also show that releases to waste water and transfers to landfills decline to zero with Alternative 1, but that releases to the air will increase. On and off-site odor information will also be contained in this table. From the conservation summary, data will show that Alternative 1 will utilize more energy than the Baseline. The Cost Analysis reviewed in Step 10 will show that Alternative 1 has higher equipment, labor, and energy costs, but lower hazardous waste costs than the Baseline. The Performance Assessment results reviewed in Step 2 will indicate that Alterative 1 yields a slightly inferior final product.

However, assessment of the social benefits and costs will demonstrate that this is just part of the story. Reductions in health risks in moving from the Baseline to Alternative 1 may reduce employee absence from illness, and therefore contribute to increased productivity, a private benefit to the firm. Another private benefit is the ability of the firm to market to environmentally concerned consumers. These consumers might try to avoid products made with the Baseline, or might be willing to pay a premium for products they consider to be "green." External benefits include reduced odor in the nearby vicinity of the plant, improved water quality in the reservoir, and reduced health risks to workers. Private costs associated with Alternative 1 are those costs which were identified in the Cost Analysis module, while external costs are associated with increased air emissions.

A table which illustrates the range of social benefits and costs can be constructed. Table 10-3 is a depiction of such a table. This table shows the social benefits and costs of Alternative 1 relative to the Baseline. Note that it may not be possible to identify either quantity or unit values for all of the items listed under type. As stated above, a review of economic literature might

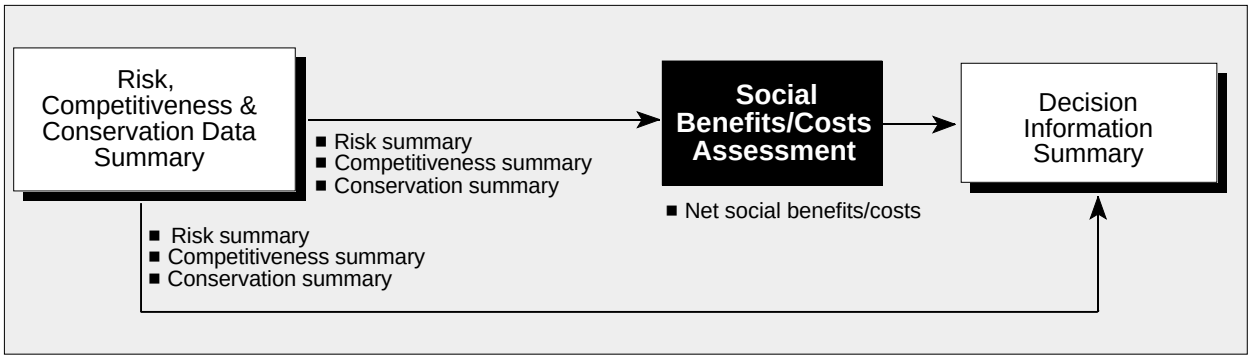
provide information, but generally resources may be too limited to provide monetary valuation of external benefits. A qualitative description should be included in that case. A problem with qualitative descriptions is the difficulty in weighing the benefits and costs - there is a tendency to ignore those benefits which are not quantified. It may be possible to get an idea of the magnitude of the qualitative description through the use of quantified aspects such as affected population size. For instance, it appears that the choice is clear in looking at benefits of $1,000 versus $50 per individual; however, if in the first case 5 individuals are affected and in the second 100 individuals are affected, the choices appear equal.

After compiling social benefits and costs information, the DfE team calculates the net benefits for each alternative. The net benefit is simply the difference between social benefits and costs. This information is then transferred to the Decision Information Summary module.

TABLE 10-3: BASELINE AND ALTERNATIVE 1: SOCIAL BENEFITS AND COSTS				
Type	**Unit**	**Quantity**	**Total Value (+, -, $)**	
			Baseline	**Alternative 1**
Benefits				
Private				
Employee productivity	$		Negative - Employees may be absent or ill on job	Positive - Fewer absences and more productive on job
Product quality	$	(Obtain from Performance Assessment)	Positive - Results in superior quality product	Negative - Inferior quality could lead to reduced sales
Odor within plant	Level (H, M, L)	(Obtain from Risk Characterization)	Negative - May cause absences, high turnover, poor morale	Positive - Reduced potential for sick days or employee turnover
Revenue from "green" consumers	$	(Obtain from Market Information)	None	Positive - May be able to sell to new consumers, or charge a higher price
External				
Health risk to workers	Worker lives saved	(Obtain from Risk Characterization)	Negative - Potential for employees to acquire lung disease	Positive - Workers less likely to suffer from lung disease
Odor outside plant	Level (H, M, L)	(Obtain from Risk Characterization)	Negative - Complaints from community	Positive - "goodwill" of community
Ambient water quality	ppm of chemical	(Obtain from Risk Characterization)	Negative - Potential source of reduced fish stocks	Positive - Possible increase in fish populations and more fishing
Potential for contamination in landfill	Level (H, M, L)	(Obtain from Risk Characterization)	Negative - Leaks could contaminate groundwater	None
Total Benefits				
Costs				
Private				
New equipment costs	$	(Obtain from Cost Analysis)	None	Positive - Must purchase new machinery
Hazardous waste disposal costs	$	(Obtain from Cost Analysis)	Positive - Must pay to dispose of chemical	None
Labor costs	$	(Obtain from Cost Analysis)	Positive	Positive - Higher than for Alpha
Energy costs	$	(Obtain from Cost Analysis)	Positive	Positive - Higher than for Alpha
Potential for liability claims	Expected value of damages	(Obtain from Cost Analysis)	Positive - High legal fees and damages if contamination event occurs	None
External				
Air emissions	Amount of particulate	(Obtain from Risk Characterization)	None	Positive - New technology causes air emissions
Total Costs				
Net Benefits				

FLOW OF INFORMATION: This module can be used to guide the selection and use of alternatives that produce societal benefits while optimizing performance and cost requirements. In a CTSA this module receives data from the Risk, Competitiveness & Conservation Data Summary module and transfers data to the Decision Information Summary module. Example information flows are shown in Figure 10-2.

FIGURE 10-2: SOCIAL BENEFITS/COSTS ASSESSMENT MODULE: EXAMPLE INFORMATION FLOWS



ANALYTICAL MODELS: Table 10-4 lists references for applications of social benefits/costs assessment and Regulatory Impact Analyses prepared by EPA that can be used as analytical frameworks for performing social benefits/costs assessments of voluntary pollution prevention opportunities.

TABLE 10-4: ANALYTICAL MODELS

Reference	Type of Model
Arnold, Frank S. 1995. *Economic Analysis of Environmental Policy and Regulation.*	Presents a wide variety of practical applications of economics to environmental policies.
Augustyniak, Christine. 1989. *Regulatory Impact Analysis of Controls on Asbestos and Asbestos Products.*	Example of an application of benefit/cost analysis for regulatory decision-making.
Clark, L.H. 1987. *EPA's Use of Benefit-Cost Analysis 1981 - 1986.*	Discusses the contributions that benefit/cost analysis has made to EPA's regulatory process and examines the limitations of benefit/cost analysis.
U.S. Environmental Protection Agency. 1993c. *Review and Update of Burden and Cost Estimates for EPA's Toxic Release Inventory Program.*	Analysis to review and update estimates of the incremental burden and costs to industry and EPA developed for the 1990 Section 313 Information Collection Request established under the Emergency Planning and Community Right-to-know Act.

Note: References are listed in shortened format, with complete references given in the reference list following Chapter 10.

PUBLISHED GUIDANCE: Table 10-5 lists sources of published guidance on social benefits/costs assessment.

TABLE 10-5: SOURCES OF SOCIAL BENEFITS/COSTS ASSESSMENT PUBLISHED GUIDANCE

Reference	Type of Guidance
Estes, Ralph W. 1976. *Corporate Social Accounting.*	Case study textbook. Provides an overview of social accounting as it has been and may be applied in corporations, government institutions, and non-corporate organizations.
Freeman, A. Myrick, III. 1979. *The Benefits of Environmental Improvement: Theory and Practice.*	Basic textbook. Technical review of application of economic tools and theory to social benefits/costs analysis.
Freeman, A. Myrick, III. 1982. *Air and Water Pollution Control: A Benefit-Cost Assessment*.	Case study textbook. Describes in layman's terms the term benefits and economist's methods for measuring benefits. Discusses tools available for social benefits/costs analysis and how they are being applied in practice.
Kneese, Allen V. 1984. *Measuring the Benefits of Clean Air and Water.*	Case study textbook of social benefits/costs analyses as applied to urban air pollution and rural and regional air and water pollution.
Mishan, E.J. 1976. *Cost-Benefit Analysis.*	Basic textbook. Theoretical discussion of environmental economics and the theory of social benefits/costs analysis.
Seneca, Joseph and M.K. Taussig. 1984. *Environmental Economics.*	Basic textbook. Introduction to environmental economics and the theory of social benefits/costs analysis.
Tietenberg, Tom. 1994. *Environmental Economics and Policy.*	Introduction to environmental economics and the theory of social benefits/costs analysis.
U.S. Environmental Protection Agency. 1983. *Guidelines for Performing Regulatory Impact Analysis*.	EPA guidelines for assessing benefits, analyzing costs, and evaluating benefits and costs.
U.S. Environmental Protection Agency. 1993d. *Guidance on the Preparation of Economic Analyses and Regulatory Impact Analysis in OPPT.*	EPA guidance for preparing economic analyses and Regulatory Impact Analyses in support of rulemakings under the Toxic Substances Control Act, the Emergency Planning and Community Right-to-Know Act, the Asbestos Hazard Emergency Response Act, and the Residential Lead-Based Paint Hazard Reduction Act.

Note: References are listed in shortened format, with complete references given in the reference list following Chapter 10.

DATA SOURCES: None cited.

DECISION INFORMATION SUMMARY

OVERVIEW: The Decision Information Summary is the final module of a CTSA. It combines the results of the Risk, Competitiveness & Conservation Data Summary module with the Social Benefits/Costs Assessment module to identify the advantages and disadvantages of the baseline and the substitutes from both an individual business and a societal perspective. The Decision Information Summary module does not include value judgements or recommendations. Instead, the trade-off issues and uncertainty in the data are summarized to enable decision-makers to make decisions that incorporate their own circumstances, while considering the results of a CTSA. A key point is that decisions about whether or not to use an alternative are made outside of the CTSA process.

GOALS:

- Compile the results of the Risk, Competitiveness & Conservation Data Summary and the Social Benefits/Costs Assessment modules for the baseline and the substitutes.

- Compile information on the uncertainties in the data that should be considered in the decision-making process.

- Identify the trade-offs among risk, competitiveness, conservation, and social benefits/costs associated with the baseline and substitutes.

PEOPLE SKILLS: The Decision Information Summary module requires the skills outlined in the previous module descriptions for the analytical components of a CTSA. Knowledgeable personnel and technical experts who completed the analytical modules are needed to evaluate results and identify uncertainties in the information. Completing this module should be a joint effort by all members of a DfE project team.

DEFINITION OF TERMS: Several terms from the Exposure Assessment and Risk Characterization modules are used in the Decision Information Summary module. Refer to these modules for definitions.

APPROACH/METHODOLOGY: The following presents a summary of the approach or methodology for preparing a decision information summary. Methodology details for Steps 1, 2, and 3 follow this section.

Step 1: Obtain data summaries from the Risk, Competitiveness & Conservation Data Summary module. The data summaries should describe any assumptions, scientific judgements, and uncertainties in the data.

Step 2: Obtain information regarding the net social benefits/costs of the baseline and alternatives from the Social Benefits/Costs Assessment module. Note any assumptions, scientific judgements, and uncertainties included in the assessment.

Step 3: Identify other factors that an individual business might consider when choosing among alternatives. Consider these additional factors when listing uncertainties in the data that should be considered in the individual decision-making process. For example, workplace practices data from large facilities may not be representative of the types of workplace practices at smaller facilities.

Step 4: Review the data and uncertainties for each alternative to determine the trade-off issues associated with any one substitute from both an individual business and a societal perspective. Note changes in trends from the baseline to the substitutes (e.g., the baseline performs well, is cost-effective, but consumes large amounts of water and has a high potential for worker exposure; an alternative performs well, is expected to be cost-effective if supply/demand relationships stabilize; and has greater net social benefits due to reduced water consumption and potential for exposure as compared to the baseline).

Step 5: In addition to publishing the Decision Information Summary in a CTSA, provide results to the communications and implementation work groups of a DfE project team. These workgroups typically prepare CTSA summary brochures that present the CTSA results in a user-friendly format. (For more information on the roles of these work groups, see the companion publication, *Design for the Environment: Building Partnerships for Environmental Improvement* [EPA, 1995a].)

METHODOLOGY DETAILS: This section provides methodology details for completing Steps 1, 2, and 3. In some cases, information on interpreting the significance of results can be found in the published guidance listed previously in other module descriptions.

Details: Steps 1, 2, and 3, Identifying Uncertainties and Other Factors Important to Decision-Making

Identifying Uncertainties in the Risk Characterization

Because information for risk characterization comes from the Environmental Hazards Summary, Human Health Hazards Summary, and Exposure Assessment modules, an assessment of uncertainty should include the uncertainties in the hazard and exposure data. There is also the issue of compounded uncertainty; as uncertain data are combined in the assessment, uncertainties may be magnified in the process. EPA guidance documents (e.g., *Risk Assessment Guidance for Superfund* [EPA, 1989a]; "Guidelines for Exposure Assessment" [EPA, 1992a]) contain detailed descriptions of uncertainty assessment, and the reader is referred to these for further information.

Uncertainties in the hazard data could include:

- Uncertainties from use of quantitative structure-activity relationships (QSARs) for aquatic toxicity.
- Using dose-response data from high dose studies to predict effects that may occur at low levels.
- Using data from short-term studies to predict the effects of long-term exposures.
- Using dose-response data from laboratory animals to predict effects in humans.
- Using data from homogeneous populations of laboratory animals or healthy human populations to predict the effects on the general human population, with a wide range of sensitivities.
- Assuming 100 percent absorption of a dose when the actual absorption rate may be significantly lower.
- Using toxicological potency factors from studies with a different route of exposure than the one under evaluation.
- Effects of chemical mixtures (effects may be independent, additive, synergistic or antagonistic).
- Possible effects of substances not included because of a lack of toxicity data.
- Carcinogen weight-of-evidence classifications; for any chemicals assessed as carcinogens (described in the Human Health Hazards Summary module), the weight-of-evidence classification should be presented with any cancer risk results.

Uncertainties in the exposure data could include:

- Description of exposure setting - how well the typical facility used in the exposure assessment represents the facilities included in the CTSA; the likelihood of the exposure pathways actually occurring.
- Possible effect of any chemicals that may not have been included because they are minor or proprietary ingredients in a formulation.
- Chemical fate and transport model applicability and assumptions - how well the models and assumptions that are required for fate and transport modeling represent the situation being assessed and the extent to which the models have been verified or validated.
- Parameter value uncertainty, including measurement error, sampling error, parameter variability, and professional judgment.
- Uncertainty in combining pathways for an individual.

In the CTSA, uncertainty is typically addressed qualitatively. Variability in the exposure assessment is typically addressed through the use of exposure descriptors, which are discussed in the Exposure Assessment module.

Identifying Uncertainties in Performance and Cost Data

The Performance Assessment module is typically designed to evaluate characteristics of a technology's performance, not to define parameters of performance or to substitute for thorough on-site testing. Thus, performance demonstration projects conducted during CTSA pilot projects are intended to be a "snapshot" of a substitutes performance at actual operating facilities.

Similarly, the Cost Analysis module evaluates the average cost of a substitute at a "typical" or "model" facility using data collected from performance demonstration sites, the Workplace Practices & Source Release Assessment module, and other sources. Neither the Cost Analysis nor the Performance Demonstration are intended to yield absolute cost or performance information, but they do result in comparative information on the relative cost or performance of the baseline and substitutes.

Uncertainties in the Social Benefits/Costs Assessment

Due to time and resource constraints, the CTSA process utilizes a qualitative assessment of social benefits and costs that does not provide monetary valuation of external benefits. A problem with qualitative descriptions is the difficulty in weighing the benefits and costs - there is a tendency to ignore those benefits or costs that are not monetized. The project team members who perform the social benefits/costs assessment may illustrate the magnitude of a qualitative description through the use of quantified aspects such as affected population size. The Decision Information Summary module should contain both the qualitative and quantitative results of the Social Benefits/Costs Assessment. The importance of social benefits/costs assessment is not to develop a precise numerical estimate of social benefits and costs, but to recognize that these benefits and costs exist and use a systematic form of analysis to identify the best alternative(s) among a choice of several possible options.

Other Factors Important to Decision-Making

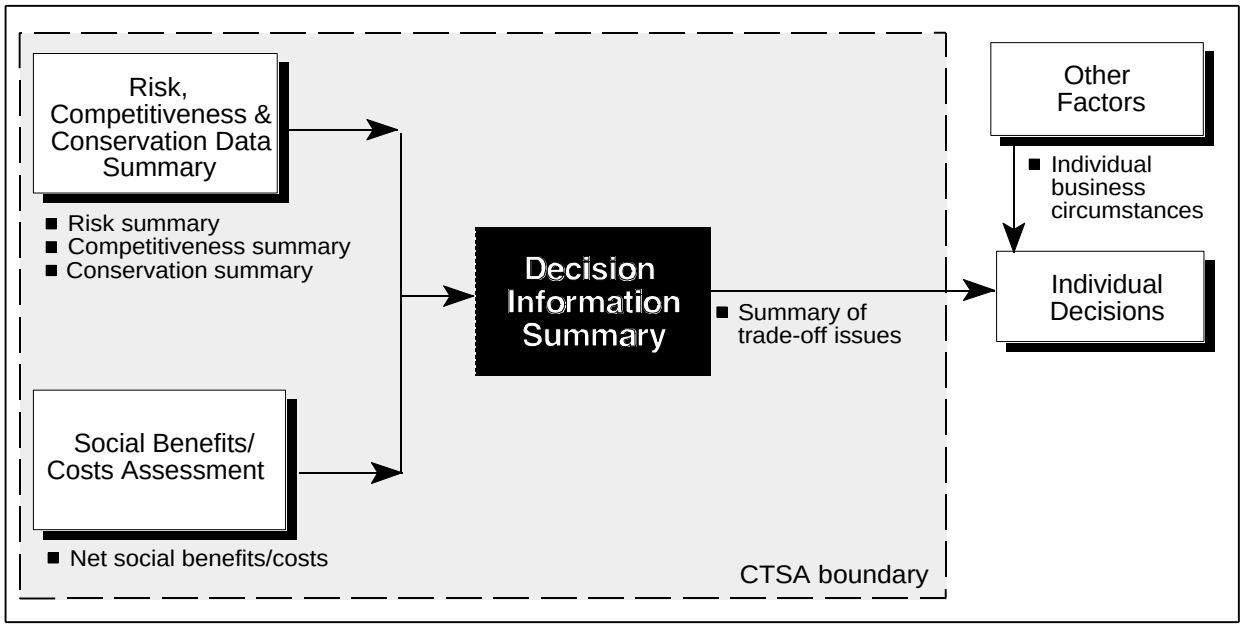
A CTSA provides comparative information on the relative risk, performance, costs and resource conservation of alternatives to individual decision-makers, but actual decisions about whether or not to implement an alternative are made outside of the CTSA process. Individual decision-makers typically consider a number of other factors before deciding upon an alternative. A few examples of these other factors include the following:

- The individual business circumstances, including cultural and political circumstances.
- The position of the business within the overall market it serves (e.g., steady, growing, shrinking).
- The status of the overall market for the product being delivered, including the outlook for long-term growth.
- The availability of funds for capital investments, if required.

FLOW OF INFORMATION: The Decision Information Summary is the final module of a CTSA. It combines the results of the Risk, Competitiveness & Conservation Data Summary with the Social Benefits/Costs Assessment modules to identify the overall advantages and disadvantages of the baseline and the substitutes from both an individual decision-maker's perspective and a societal perspective. The actual decision of whether or not to implement an alternative is made by individual decision-makers outside of the CTSA process, who typically consider a number of other factors, such as their individual business circumstances, together with the information presented in a CTSA. The relationship of the CTSA process to the actual

decision-making process and example information flows among the final modules of a CTSA are shown in Figure 10-3.p

FIGURE 10-3: DECISION INFORMATION SUMMARY MODULE: EXAMPLE INFORMATION FLOWS



ANALYTICAL MODELS: None cited.

PUBLISHED GUIDANCE: None cited.

DATA SOURCES: None cited.